

**CONTAMINATED SITES
STANDARDS REVIEW WORKSHOP
MARCH 20 - 22, 1996**

**BC ENVIRONMENT RESPONSES TO
EXPERT PANEL RECOMMENDATIONS**

**Industrial Waste and Hazardous Contaminants Branch
Environmental Protection Department
Ministry of Environment, Lands and Parks**

September 16, 1996

1.0 Introduction

In late 1994 BC Environment released for comment draft 3 of the Contaminated Sites Regulation under the *Waste Management Amendment Act*, 1993 (Bill 26). Some stakeholders including local governments, the Business Council of British Columbia and Council of Forest Industries indicated that they would appreciate an independent review of the proposed environmental quality standards. In response, the ministry agreed to hold a workshop to review the proposed standards, with the review being carried out by an independent panel of scientists and experts nominated by key stakeholder groups consulting on the draft regulation.

The stakeholder groups invited to nominate expert panel members were the Business Council of BC, the Union of British Columbia Municipalities (UBCM), the Urban Development Institute (UDI), the BC Ministry of Health, and the Westcoast Environmental Law Association (WCELA). A summary of the facilitation, panel membership, objectives and format of the workshop appears in Appendix 1.

2.0 Recommendations

The expert panel provided five consensus recommendations during the last afternoon of the workshop. In addition, each panel member was invited to submit recommendations in a personal report directly to the facilitator. The final workshop report contains the five consensus recommendations in section 4.1, and the individual panel member responses are contained in Appendix C of the report. All members except Dr. Francis Law submitted individual responses to the facilitator.

2.1 BC Environment Responses to Panel Consensus Recommendations

BC Environment agrees with, and accepts, each of the five expert panel consensus recommendations.

Consensus Recommendation 1

It is not scientifically defensible to have single number criteria or standards for all sites in British Columbia. The panel encourages BCMOELP to emphasize and further refine site-specific criteria and prepare accompanying guidance documents on the generation and implementation of these site-specific criteria.

Response

Scientific Applicability of Cleanup Criteria

BC Environment agrees that single number generic criteria or standards are not scientifically applicable to all sites, because they are not site-specific. That is the reason that draft 3 of the regulations contained 4 types of standards: generic numerical standards, matrix numerical standards, site-specific numerical standards, and risk-based standards. The most site-specific approach is to carry out a quantitative human health risk assessment, plus an environmental impact assessment, as described in Section 17 of draft 3 of the Contaminated Sites Regulation and in past and current ministry policy.

While the risk-based approach is more site-specific, it can be considerably more expensive to implement, and has been the option of choice for only about 5% of the sites in BC. In contrast, single number criteria have the advantage of being easy to implement, are also protective of the human health and the environment, and are used in many jurisdictions throughout North America, Europe, Australia, and New Zealand.

BC has always offered stakeholders the option of choosing either the numerical or risk-based approaches since the late 1980's and continues to offer both approaches in the draft Contaminated Sites Regulation. The draft regulation offers a choice of 3 numerical standards options and one risk-based standards option.

Commitment to Matrix and Site-specific Standards

BC Environment confirms its commitment to emphasizing and refining site-specific standards for managing contaminated sites in BC. To our knowledge, BC is the first jurisdiction to offer the options of matrix numerical standards or developing site-specific numerical standards for contaminated sites. This option was developed in close consultation with medical health officers and the Ministry of Health, following introduction of the concept in 1991 by the Canadian Council of Ministers of the Environment (CCME).

Equations and models which may be used to develop site-specific standards have already been created as part of the draft 3 standards development process, and are contained in introductory documentation provided to the expert panel and available to stakeholders since early 1996. In addition, the ministry is prepared to accept the use of alternate models for development of site-specific numerical standards provided the proponent provides adequate documentation to verify the validity of the model, and funds any extraordinary review costs.

Commitment to Providing Guidance Documentation

BC Environment also confirms its commitment to provide guidance documentation on the development and use of the models to calculate site-specific numerical standards. Stakeholders were provided a list of protocols to be developed as part of the Contaminated Sites Regulation in the fall of 1995, and a revised version of this list was provided to the expert panel members during the workshop. The highest priority item on this list is the preparation of the protocol for the calculation of site-specific soil and water quality standards. A copy of the complete list of protocols to be developed pursuant to the Contaminated Sites Regulation is contained in Appendix 2.

Consensus Recommendation 2

BCMOELP is encouraged to review its standards every 3 - 5 years and amend its standards accordingly to reflect the evolution of science and the generation of new data. BCMOELP staff are encouraged to meet with the Panel or a similar panel every two years to accomplish this review.

Response

BC Environment is committed to deriving standards for contaminated sites based on the best available science, and on the best scientific advice. The standards proposed in draft 3 of the Contaminated Sites Regulation make use of the latest data available from the CCME, and reflect the thinking of multidisciplinary experts, including medical health officers, and scientists and physicians from BC Environment and the Ministry of Health.

In addition, the standards in the regulation have been subjected to scrutiny by two independent panels of experts. The first meeting, a two-day session in September 1995, was held to review their environmental aspects. The second was the workshop which is the subject of this report. In addition, thousands of copies of the draft regulation have been circulated to stakeholders for comment. Many key stakeholder groups have made detailed scientific comments on the derivation and application of the proposed standards.

BC Environment intends to maintain a high level of scientific assessment and evaluation of its contaminated sites standards. It is also intended that matrix numerical standards will be created for substances which currently remain as generic numerical standards as data becomes available. This is expected to be an ongoing process rather than an activity that is conducted only every 3 to 5 years. BC Environment commits to an appropriate stakeholder review to assess new standards as they become available.

Consensus Recommendation 3

A site should not be labelled a "contaminated site" while it is still undergoing evaluation no matter what tier or part of the evaluation it is undergoing. Until the site is either finally declared to be contaminated or in compliance with the standards, the site's status should be declared "under evaluation" or similar neutral term.

Response

The ministry will not formally label a site as contaminated except under very specific circumstances. Contamination is a relative term and an individual site will only be considered relative to a particular use, which determines the appropriate standard. While a site is undergoing investigation relative to a particular standard, it is simply "under assessment."

To ensure sites are not mislabelled, Bill 26 contains a provision in Section 20.3 called "Determination of Contaminated Site". This determination will usually be made at the request of a site owner or a person affected by a site. It will not be required for every site. For example, many sites will be assessed and remediated through independent remediation or voluntary remediation agreements. In these cases, responsible parties will have already concluded that their sites are contaminated and no formal determination or label will be necessary.

In cases where a formal determination is requested, the process will usually involve two steps. A preliminary determination will be made, followed by a period where any person may comment on the results of the preliminary determination. Only following this comment period will a final determination be made.

Consensus Recommendation 4

The site-specific matrix and risk evaluation methods both should have the maximum flexibility built in. The proponents of a site should be able to use models other than those chosen by BCMOELP. A broader range of parameters for these models should be allowed.

Response

BC Environment proposes to allow two different types of processes to establish site-specific standards under the Contaminated Sites Regulation. A fast-track method involves calculating site-specific standards using models already accepted by the ministry. A slower track method would allow the proponent to use a different model, which would be assessed and approved by the ministry on a case-by-case basis. The latter would require in-depth review by ministry staff, so it would take longer to complete the approval process. In either case, the choice of the method would be up to the proponent, but with the latter there would be some risk that the ministry would not accept the proponent's proposed model.

Similarly, in using the risk-based standards, a proponent may use standard models already approved by the ministry, or alternate models accepted by the ministry after appropriate evaluation.

Consensus Recommendation 5

Guidance documents that aid in the implementation of the risk evaluation tier should be prepared and distributed. These guidance documents would describe in greater detail how the risk evaluation would be performed.

Response

The development of guidance on a number of issues was anticipated in the regulation in Section 47. Subsection 47 (1) (e) enables the Director of Waste Management to approve or adopt protocols for carrying out risk assessment.

The development of protocols and guidance for environmental impact assessment and human health risk assessment have also been planned and are listed in the schedule contained in Appendix 2. The ministry recently began contract work to develop environmental impact assessment guidance in 1996. Guidance for human health risk assessment has been provided for a number of years, and this is scheduled to be revised in 1997. The reader should also refer to the response to consensus recommendation 1 for the ministry position on providing guidance documentation.

2.2 BC Environment Response to Individual Panel Members' Recommendations

Expert panel members also provided 83 individual recommendations which were analyzed and sorted into 12 categories. The following summarizes the responses to all 88 recommendations:

<u>Type of BC Environment Response</u>	<u>Percentage of Total</u>
Accepted (54)	61%
Under consideration (6)	7%
Not Accepted (28)	32%
• Agree on need to address issue but different response is required (18)	21%
• Differ in interpretation of provision in draft regulation (3)	3%
• Disagree with both need to address issue and recommended response (7)	8%

The following discusses BC Environment's responses to the expert panel's recommendations in each of the 12 categories.

Guidance

In addition to the two consensus recommendations involving guidance documentation, another 11 recommendations from individual panel members focused on this issue. This general issue received the greatest number of comments from panel members. BC Environment accepts every recommendation in this category. The ministry affirms its commitment to develop, consult and provide training and guidance on implementation of the standards, on Section 47 protocols (including risk assessment, determination of background levels of substances, analytical methods, modelling, sensitivity analysis of models), on soil relocation requirements, and on using site-specific information in developing site-specific standards. The reader is referred to Appendix 2 for the ministry's plans to provide guidance and protocols.

Level of Protection for the Environment

There were four recommendations from individual panellists concerning the protection that BC Environment has proposed to provide to the environment.

The ministry accepts the recommendation to clarify its intentions to protect wildlife. An amendment to the draft regulation is being considered which would indicate that the past land use at a site would apply to a site at which none of the five defined land uses were currently applicable.

The recommendation that a minimum of a cursory overview of ecosystem health at a site be carried out as part of a basic site assessment is also accepted. This will be recommended for incorporation into guidance for preliminary site investigations.

One panel member said that chromium +3 and +6 were relatively nontoxic to soil invertebrate and plants, and suggested that the intention to set soil invertebrates and plants matrix standards for chromium +6 be re-examined. The ministry has reviewed this issue, and is considering deleting the matrix for chromium +6. In its place, a matrix combining standards for both total chromium and chromium +6 would appear. The new soil invertebrate and plant standards would be adopted from the less stringent generic numerical standards for total chromium into the new matrix. The human health portion of the matrix would continue to be based on chromium +6.

The recommendation to delete a statement in Contaminated Sites Soils Taskgroup (CSST) documentation "it is assumed that the level of protection provided for soil dependent species will also be generally adequate for the protection of livestock and wildlife" was not accepted. This statement accurately records an assumption made by CSST in driving proposed standards for environmental protection.

Environmental Mobility and Bioavailability

There were eight recommendations from panel members on environmental mobility and bioavailability. One recommendation called for site-specific standard setting guidance to allow the use of bioavailability in the assessment of human health and toxicity to soil invertebrates and plants. The ministry accepts this recommendation, and intends to incorporate this concept into guidance being prepared on setting site-specific standards.

The remaining seven recommendations are proposed to be addressed by a multistakeholder committee to advise BC Environment on methods to address mobility and bioavailability in the Contaminated Sites Regulation. Issues such as the following identified in recommendations by individual committee members would be referred to this committee:

- development of protocols to assess leachability of substances from soil;
- adoption of a default bioavailability factor different from 1.0;
- development of chemical extraction methods to estimate the uptake of substances by plants and soil invertebrates;
- adoption of appropriate analytical chemistry extraction techniques for metals such as barium; and
- applicability of field data in deriving standards to account for bioavailability.

Models and Modelling

In addition to panel consensus recommendation 4, another seven recommendations were provided by individual panel members on the use of models in deriving standards for contaminated sites. BC Environment accepts the

recommendations to consider relevant scientific literature on groundwater modelling and for review of groundwater models used. The latter will be part of a future review of the standards as described in the BC Environment response to the panel's consensus recommendation 2. The remaining recommendations by individual panel members on modelling are not accepted.

The notion that the ministry should not derive matrix soil numerical standards for metals for the protection of groundwater (Schedule 5) counters the virtually unanimous advice the ministry received at the CSST Workshop on the Development and Implementation of Soil Quality Standards for Contaminated Sites, as recorded in the October 1995 summary report prepared by facilitator Donald D. MacDonald. This workshop emphasized the importance of developing soil quality standards for the protection of groundwater, and advised that a variety of means should be considered for metals and polar organics. In addition, it is becoming increasingly recognized that preventing groundwater contamination must be a priority.

Following that workshop, ministry staff analyzed the groundwater and soil quality data for a number of sites. This review revealed that groundwater was sometimes contaminated with metals, even though existing soil quality criteria, which did not account for groundwater protection, had been met. BC Environment concluded that both short-term and long-term steps should be taken to address this issue. The short-term result was the modelling and incorporation of groundwater protection standards in the matrices for metals in Schedule 5 of draft 3 of the regulation. A long-term project will be to develop better mathematical and physical models to assist in this process.

It is important to recognize that the matrix numerical standards are not mandatory standards. If site owners do not wish to use the matrix numerical standards, they are not required to do so. Different models may be used to estimate the movement of substances from soil into ground and surface water in the site-specific standard and risk assessment approaches.

The statements that the MINTRANS or PHREEQC models should be used in deriving matrix standards were not accepted. This is because they are complex, sophisticated models that will provide results with considerable precision, when less sophisticated models are acceptable for the job. The modelling results depend to a very large extent on the science policy decisions made in choosing variables to use in the models, rather than in the precision of the models themselves.

The ministry does not accept the statements that the K_d values used to model groundwater transport of metals are incorrect or that the K_{oc} values used are lower than they should be, resulting in groundwater standards which are too low. There is considerable variation in K_d and K_{oc} values in the published literature. BC Environment, consistent with CSST policy, used constants as published by the CCME, if available, in developing the matrix standards. For developing site-specific

standards or carrying out risk assessments, other values may be more appropriate. With respect to pentachlorophenol, the BCE model does incorporate sorption of the neutral and ionized species. The selection of sorption coefficients and the acid dissociation constant are based on work by Schellenberg *et al*, 1984, and Mackay *et al*, 1992. The approach used by CCME is similar to that used by Lee *et al*, 1990. Different constants were used, however, so different values resulted.

Managing Odour

Seven recommendations focussed on the ministry's efforts to develop standards for control of odours from substances in soil. The proposed standards relate primarily to benzene, toluene, ethylbenzene, and xylene, common components of gasoline and other fuels.

The panel noted problems with the derivation of the proposed odour protection standards, particularly with the models used. BC Environment recognizes the need for further work to establish more defensible standards for odour protection. Accordingly, we are proposing to delete all the odour standards contained in the matrix numerical standards. In their place, BC Environment is considering incorporating a qualitative requirement in the generic numerical standards that odorous substances simply not be present in excess of quantities acceptable to a regional manager from the ministry.

The ministry accepts three of the seven recommendations on odour:

- it is willing to examine other models to derive odour standards,
- will consider basing odour standards derived from an excavation model proposed by the Canadian Petroleum Products Institute representative at the workshop, and
- will not adopt quantitative odour protection standards based on the current model used for draft 3 of the regulation.

The ministry is now proposing to adopt qualitative odour standards in Schedule 4, the generic numerical soil standards, as described above. BC Environment is considering a project with several partners in the private sector to examine a range of models for the transport of volatile substances in soil to air.

The remaining four recommendations in this section are not accepted:

- Guideline screens rather than legal standards should be used for odour protection (recommendation by two panel members).

Response: The generic and matrix standards in Schedules 4 - 6 may already be used as screens. Persons responsible may always develop site-specific standards or use the risk-based approach. Thus, a site which would be considered contaminated using the generic or matrix standards, may not be considered contaminated using the site-specific standards approach. The choice of which type of standards are used is made by a proponent.

- Ascertain that human health risk is acceptable regardless of the odour threshold.
Response: CSST has recognized that both the aesthetic effects and human health risks of odorous substances transported from soil to air need to be managed. The assessment of health risks and odour potential for volatile substances both rely on the use of models. Just as BC Environment has had difficulty in finding an acceptable model to develop appropriate odour control standards, the same problem relates to models for developing standards to protect against human health impacts. For this reason, CSST has decided at this time not to recommend soil quality standards for the protection of human health from the inhalation of volatile substances in air.
- Within the site-specific standards process, allow for air monitoring of volatile compounds as an alternative to standards for odour protection.
Response: This recommendation confuses the development of standards with the implementation of standards. Risk decisions based on monitoring relate to risk management activities, not to the development of site-specific standards.

Regulatory Consistency

There were three recommendations indicating that provisions in the Contaminated Sites Regulation should be consistent with other provincial requirements. All three are accepted.

Two of the recommendations are identical, calling for reconciliation of the Contaminated Sites Regulation's groundwater standards with provincial discharge standards. While standards in different regulations serve different purposes, to the extent feasible, it is the ministry's intent to reconcile the standards proposed in the Contaminated Sites Regulation with existing discharge standards. To this end, BC Environment is considering incorporating a dilution factor in the Schedule 6 aquatic life standards, by multiplying the proposed draft 3 standards by 10. The rationale behind this is that for most sites, it is expected that groundwater will not totally constitute the water used directly by aquatic life, and that a minimum of 10:1 dilution will occur at most sites where groundwater is an issue.

The other recommendation suggests that Section 12 of the draft regulation be revised so that soils would only be exempted as special waste. The Special Waste Regulation under the *Waste Management Act* defines what wastes are special wastes. The provision in section 12 already proposes to exempt certain soils from the Special Waste Regulation definition. Thus BC Environment accepts this recommendation, and is also considering revised wording to enhance the clarity of the section.

Application of Standards

In addition to panel consensus recommendation 3, there were seven other recommendations relating to the application of the standards proposed in draft 3 of the Contaminated Sites Regulation. Three of these recommendations are accepted (two of these are the same), but the remaining four are not. The recommendations

that the ministry accepts are already intended and incorporated into the legislation and draft regulation.

BC Environment accepts that the regulation should recognize that some commercial or industrial uses would effectively remove a site from the productive ecosystem, and that exemption of such sites from ecosystem protective standards should be allowed. It must be emphasized that the mere exceedance of a particular numerical standard would not always require site remediation. The risk-based approach may always be used, and the environmental impact assessment component of this approach may well indicate that no particular new initiatives to protect or restore ecosystems or the environment are required.

The recommendation that the regulation should allow BC Environment to require evaluation of sites, and if this is not done in a timely manner, then could complete the work and recover costs, is already part of the legislation, particularly in Section 20.93 of Bill 26. Further provisions are not necessary in the regulation.

The suggestion that the site profile form be amended to incorporate a question about the status of plants growing on a site is not accepted because this is considered part of a site investigation. Site profiles are designed to be filled out by persons without recourse to a site visit. BC Environment intends to incorporate this requirement into a preliminary site investigation or detailed site investigation prepared for a site.

A second part of this recommendation is that qualitative information on the growth of plants could be used to adjust matrix standards. This is not accepted because the mere presence of plant growth at a site does not mean that a site is ecologically healthy. Many sites that are contaminated would still be able to support some plant growth. Such considerations would more properly be part of developing site-specific standards or carrying out an environmental impact assessment for a site.

The following recommendations are also not accepted:

- Guideline screens rather than legal standards should be used.

Response: The generic and matrix standards in Schedules 4 - 6 may already be used as screens. Persons responsible may always develop site-specific standards or use the risk-based approach. Thus, a site which would be considered contaminated using the generic or matrix standards, may not be considered contaminated using the site-specific standard approach. The choice of which type of standards are used is made by a proponent.

- Contaminated soil relocation agreements should not be triggered for scenarios where numerical soil standards would be applied to a receiving site.

Response: These agreements are needed to document the movement of contaminated soil and to prevent contamination of soil deposit sites.

- The soil ingestion pathway should only be used in analyses if the soil is within 1 metre of the surface, enabling ingestion.

Response: If this were done, some mechanism to ensure that the soil would remain in place would be necessary. For example, a covenant to never move or excavate the soil could be required, but this is administratively impractical. The risk-based approach is a more straightforward method of dealing with this issue.

Development of Standards

The expert panel members provided 11 recommendations for the ministry to consider on the development of standards. Six are accepted, and the rest are not.

Four of the recommendations accepted are already incorporated or underway:

- BC Environment studies of the background levels of substances in soil and groundwater are available, and work is progressing in this area. The final year of a three-year study on background levels in soil will be completed in 1996.
- Work is underway under the auspices of the CCME to enhance our ability to set scientifically-defensible standards for the protection of soil microbes. CSST recommends that microbial soil protection standards only be adopted after final approval of methods by the CCME.
- BC Environment intends to work in partnership with others to develop bioassays for determining the toxicity of various petroleum hydrocarbon fractions. These results may be used in the future to develop matrix standards for petroleum hydrocarbon fractions such as VPHs, LEPHs, and HEPHs, currently contained in Schedule 4 of the draft regulation.
- Standards have not been developed where there is insufficient data. If there is insufficient data to derive a matrix standard, the matrix cell has been left blank, and a footnote indicates that the appropriate data is not available.

The remaining two recommendations that are accepted will be addressed in the future. A review of the Apparent Effects Threshold (AET) approach to setting sediment quality standards and of American guidelines for deriving water quality criteria may produce ideas that can be incorporated into the future BC process for developing contaminated sites standards. The recommendation that additional data is needed to improve toxicity correlations for cadmium, lead, and pentachlorophenol is acknowledged, and the ministry commits to re-evaluate the standards as new data becomes available.

The following recommendations are not accepted:

- A table of standards for each major soil type in the province should be developed (two recommendations).

Response: Accepting this recommendation would result in a number of matrices for each metal, increasing the complexity of Schedule 5 significantly. The site-specific standards and risk assessment processes are more practical approaches for addressing differing soil types. The ministry commits to providing appropriate guidance for different soil types for these types of standards.

- British Columbia specific bioassay data should be developed for application in deriving plant and invertebrate matrix standards.

Response: Such data would be interesting to review, but could take years to compile and could be very expensive to obtain.

- The regulation should incorporate ecological control standards, using species diversity indices, total productivity, respiration values and presence/abundance of appropriate indicator species.

Response: The state of the science for deriving ecological soil numerical standards is too rudimentary to use these parameters in the derivation of matrix standards. Even if it were practical to carry out, the work involved would be very onerous compared to that currently planned by the ministry.

- Obtain more field empirical data upon which to base soil standard and evaluations. Evaluate:

- all soil chemistry, chemical state (pH, red/ox) and content (organics, clays/silt/sand) parameters,
- all groundwater chemistry parameters,
- ecological parameters, and
- biological uptake factors.

Response: These are factors that may be considered and used in the development of site-specific standards and risk assessments. A project to develop matrix standards based on these factors would take years.

Review of Proposed Standards

The expert panel provided consensus recommendation 2 to ensure that the standards were adequately reviewed. There were eight other recommendations from individual panel members on this issue. Two of these are accepted, two are under consideration, and the remaining four are not accepted.

BC Environment accepts the recommendation that data from the US National Research Council on mineral tolerances of domestic animals should be compared with data from the Ministry of Agriculture, Fisheries and Food used to develop the matrix standards. It should be noted that the American data is much older and less complete than that from the Ministry of Agriculture, Fisheries and Food that was used to derive the matrix standards. It will be incorporated into BC Environment's ongoing standards review process.

We also agree with the statement that adoption of Water Quality Branch/CCME water quality criteria as standards in regulation without review of water background concentrations and analytical capabilities is unacceptable. As explained earlier, the issue of assessing background levels of substances in BC has been underway for several years, and a project to determine background levels of substances in groundwater has been initiated. As well chemical analytical issues have been considered, and a few changes will be proposed in future drafts of the regulation to account for standards in draft 3 that were below routine detection limits.

One panel member recommended using the same percentile adjustment to modify the toxicologically-based standards to account for background levels of substances in groundwater as was used for soil. This would ensure that both groundwater and soil would be provided the same type of adjustment to account for background levels of substances. The recommendation is well worth considering, but since an assessment of groundwater background levels in BC is not complete, the ministry is not yet prepared to follow up this recommendation.

Another recommendation was for a technical advisory panel to be formed to advise BC Environment on complex issues such as modelling of groundwater transport of substances. BC Environment commits to an appropriate review process for new standards and models as they become available, but not to create a technical advisory panel.

The following recommendations are not accepted:

- Actual sources of livestock toxicity information should be retrieved and evaluated.

Response: BC Environment has already agreed to review the US mineral tolerance data from the National Research Council. It will be compared to data provided by the Ministry of Agriculture, Fisheries and Foods. The Ministry of Agriculture, Fisheries and Food has reviewed draft 3 of the regulation and concurs with its provisions. That ministry is responsible for maintaining mineral tolerance data and will be informed about the concerns of the panel member.

- An effort should be made to assess the degree of conservatism and briefly review the rationale for the ambient water quality criteria used in developing the standards in Schedule 6.

Response: CSST had no intention of deriving new water quality parameters for use in the Contaminated Sites Regulation. That process could take years to complete. The CSST policy is to adopt existing water quality criteria from BC Environment and the CCME as standards. The ministry's Water Quality Branch has been alerted to these concerns, and a project to reassess several water quality parameters is now underway.

- A capping margin of three, instead of two standard deviations, should be used to adjust the toxicologically-based standards with background levels of substances.

Response: BC Environment does not consider the 99th upper percentile to be sufficiently protective for use in the Contaminated Sites Regulation for this purpose.

Transparency

One panel member made six recommendations about the scientific transparency of the material provided to panel members for the workshop. Transparency relates to the ease in which a reader may follow the scientific arguments and rationale. One of the key goals of CSST has been to be completely transparent, and BC Environment agrees with all six recommendations.

In particular, the panel member recommended:

- explicit statements be made about the adjustment of toxicologically-based standards with background limits – this already is provided in footnotes to the matrices in Schedule 5.
- explicit discussion of default values used in models be provided in support documentation – this is already provided in the document "Overview of CSST Procedures for the Derivation of Soil Quality Matrix Standards for Contaminated Sites."
- explicit policy decisions should be stated on estimates of parameters in models to set single matrix standards for all soil types in the province – this has been provided in the document "CSST Policy Decision Summary: Policy/Decision Issues relating to Canadian Council of Ministers of the Environment Protocol and Site-Specific Objectives Documents."
- clarify environment goals for all ecologically relevant standards – the documentation is already provided in the ministry's Water Quality Criteria documents, as well as the CSST reports in the two previous bullets.
- rationales should be given for bioavailability and soil ingestion terms in the derivation of standards to protect human health (two recommendations – this has been already provided in the document CSST policy decision summary).

Verification of Standards

This category contains seven recommendations. Three are accepted by the ministry, and four are not.

Two of the recommendations involve the ingestion of cadmium by humans. One panel member recommended that an adjustment of the proposed matrix standards be based on actual effects-based (health impact) data. In principle, this is accepted, but the data to do this does not exist. As a second choice, the cadmium standard has been developed based on exposure data, measurements of cadmium in urine of persons exposed at sites.

A second recommendation is to formally model and peer review the pathway of human ingestion of cadmium from vegetables. Since no reliable model exists, this work cannot be carried out, so the recommendation is not accepted. CSST chose to use real world exposure data instead. The Ministry of Health rationales will provide additional background information on this issue.

Recommendations to a) review ministry site file information on metal contamination of groundwater and site soil and geochemical conditions and b) document the pathway of recharge of surface water and cite field verified sites where groundwater discharges to surface water have negative impacts are accepted. This was carried out before the expert panel convened and is described in the section on models and modelling.

A recommendation to subject plant and invertebrate standards to scientific reality checks are not accepted for the short term, but will be considered in the future. The suggestion to perform field measured reality checks for soil microbial standards using legume crop data is also not accepted, because this is viewed as more properly being conducted as part of the development of site-specific standards.

A final recommendation in this category is to provide a rationale and scientific assessment to define the true extent of problems posed by contaminated sites in BC. This issue was carefully considered before Bill 26 was passed, and was the subject of consultations with many stakeholders. Discussions with stakeholders on the draft Contaminated Sites Regulation confirm the desire to implement this legislation to address a host of problems, including, but not limited to human health, environmental, infrastructure, economic, development, and legal issues.

Miscellaneous Issues

Three of the four remaining recommendations were made by one panel member, and they focus on the process that BC Environment would use to follow up the workshop. All three of these recommendations are accepted. BC Environment agrees to provide responses to the workshop report, to inform the expert panel members of the BC Environment responses, and to document changes proposed to the regulation based on the expert panel recommendations.

The final recommendation in this category deals with the availability of resources to review site-specific standards and risk assessments in a timely manner. The ministry accepts this recommendation, and already has a number of in-house staff to carry out this function. Under the Contaminated Sites Regulation, site owners will also be able to access external contract reviewers to speed up the review process if they wish.

APPENDIX 1

Workshop Facilitation

The ministry appointed Dave Clark of M.M. Dillon Ltd. to facilitate the workshop, to verify the expertise of the nominees, to confirm their willingness to provide independent comments, and to produce a final workshop report. This document summarizes the BC Environment response to the final report prepared by Dave Clark.

Expert Panel Membership

The expert panel consisted of seven members. Five were nominated by stakeholder groups:

Dr. Alan Rubin
Health and Ecological Criteria Division
US Environmental Protection Agency
Washington, D.C.

Nominated by: UBCM

Dr. Dennis Konasewich
Envirochem Services
North Vancouver, BC

Nominated by: BC Business Council

Dr. Jim Malick
Norecol, Dames and Moore
Vancouver, BC

Nominated by: UDI

Dr. Anne Fairbrother
Ecological Planning and Toxicology Inc.
Corvallis, Oregon

Nominated by: BC Business Council

Dr. Francis Law
Department of Biological Services
Simon Fraser University
Burnaby, BC

Nominated by: WCELA

The remaining two members were appointed by Dave Clark, with the approval of key stakeholders, in order to ensure that in depth expertise in hydrogeology was available, and that the perspective of persons responsible for cleaning up contaminated sites was available:

Scott King, MSc
King Groundwater Science, Inc.
Pullman, Washington

Nominated by: M.M. Dillon Ltd.

Robert Schutzman, PEng
Director, Environmental Affairs
IPSCO, Inc.
Regina, Saskatchewan

Nominated by: M.M. Dillon Ltd.

Workshop Objectives

The following general objectives were established for the expert panel workshop:

- BC Environment to receive a review of environmental quality standards proposed in the Contaminated Sites Regulation by an independent panel of scientific experts.
- Key stakeholder groups with concerns about the proposed standards to have input into which experts are on the panel
- Stakeholders to have representatives to observe the review
- Review to be facilitated independently and recorded
- BC Environment to receive scientific recommendations and workshop report

Workshop Format

The stakeholders agreed to the following workshop format:

- Workshop to be facilitated by Dave Clark, M.M. Dillon Limited
- Expert panel members to hear presentations on the standards proposed in draft 3 of the Contaminated Sites Regulation and changes under consideration since draft 3 was released for comment.
- Speakers from BC Environment and the Ministry of Health to provide presentations summarizing the rationale and methods underlying derivation of the proposed standards.
- The workshop to contain sections on major topics.
- Panel members to be invited to ask questions and comment throughout each section.
- Major standards issues identified by stakeholders in draft 3 of the regulation to be addressed in each appropriate section.
- A wrap-up session led by the facilitator to highlight the key findings.
- The facilitator to prepare a final workshop report summarizing key findings and recommendations.

Appendix 2: Status of Protocols for Contaminated Sites Regulation

Item	Description	Priority	Status	Comments
Site-specific soil and water quality standards	Scientific procedures for deriving site-specific environmental quality standards from basic equations and assumptions provided by the ministry	1	Equations have been created as part of the matrix standards development process. Protocol being written. Introductory document is available.	To enable site-specific standards to be a practical reality, procedures will have to be created to guide consultants in the use of this type of numerical standard.
Statistics and evaluating data	Advice for consultants on how to statistically deal with the number of samples required and whether a given volume of soil is contaminated or clean	1	Draft fact sheets and guidance were released for comment in July 1996.	16 statistics fact sheets have been drafted but require editing. Advice entitled "Contaminated Site Characterization and Confirmation Testing Guidelines" and criteria for characterizing volumes of material have been available for several years.
Tests to estimate the bioavailability of substances in soil	This consists of tests and physical models which can be used to estimate the amounts of substances in soil which would be available to plants and animals.	1	Not started.	BC's numerical standards have been developed based on the assumption that 100% of a substance in soil is biologically available. To more accurately predict bioavailability, test methods are needed. A committee to advise on these methods is proposed.
Laboratory methods for analysis of soil, water, and other media	Advice for consultants and analytical laboratories on what methods should be used to prepare samples and analyze them	1	Work is underway for inorganics and petroleum hydrocarbons. Draft analytical procedures for VPHs, LEPHs and HEPHs were released for comment in July 1996.	Labs have sometimes used different methods for preparing and analyzing samples from sites. Work is now underway to develop standard analytical protocols for a variety of inorganic and organic substances, for publication in the ministry analytical manual.
Environmental impact assessment	Advice for consultants on BC Environment's requirements for environmental impact assessments	1	Contract for developing guidance is underway.	The ministry has provided guidance on environmental impact assessments by reference to work of other jurisdictions. BC guidance document needs to be developed, including provisions for controlling and measuring these impacts.

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Determining local background concentrations	Involves technical procedures to establish statistically the local background levels of substances for a given area	1	Planning underway.	A site will not be deemed a contaminated site if the concentrations of substances exceed numerical standards, and those levels are below local background concentrations.
Evaluating site conditions concerning soil relocation	Advice will be required to guide consultants on what the ministry's requirements are regarding the assessment of potential sites where contaminated soil may be relocated	2	Not started.	Guidance is necessary to help ensure that unacceptable onsite and offsite impacts do not occur from the relocation of soils from contaminated sites.
Allocation panel procedures	These protocols guide the conduct of allocation panels and also how they are used by the public and ministry	2	Not started.	
Formats - site investigation reports and remediation plans	Standard formats for site investigation reports and remediation plans will be provided.	2	Checklists are being created which will form the basis for a protocol.	Standardizing the formats of these documents will help ministry and external consultants make efficient use of their time, and should reduce the number of plans and reports returned to consultants for further work.
Modelling physical, chemical and biological processes	The analysis and characterization of human health and environmental risks often uses mathematical models. Advice is required on what models the ministry will accept and how they should be applied	2	Currently groundwater transport models being used for nonpolar substances and being reviewed for polar substances. Air models are under investigation.	Models have been used for many environmental media at sites on a case-by-case basis. This has been acceptable to the ministry for a number of years. In the future, the ministry may wish to provide requirements for models in formal protocols.

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Item	Description	Priority	Status	Comments
Sampling soil, water and other media	Advice for consultants on how to sample media at sites which may be contaminated.	3	Detailed guidance not started. Considerable information is already available in technical and regulatory literature. Some high level information is available from BC Environment Laboratory Services Section	Consultants have sampled sites for many years following procedures accepted by the consulting industry. There appear to be few issues which require immediate attention.
Human health risk assessment	Advice for consultants on BC Environment's requirements for human health risk assessments	3	Contract to be issued in fiscal year 96/97 if funds are available.	The ministry has provided guidance on human health risk assessments, by reference to requirements of other jurisdictions, by developing a risk assessment framework, and by providing reference values. Detailed BC guidance needs to be developed.
Preferred remediation approaches	This consists of advice for consultants on the preferred options for the remediation of certain types of sites	4	Not started.	It may be useful for the ministry to convey its expectations regarding practical, effective technologies for cleaning up sites. This will guide responsible persons away from technologies that are impractical or ineffective.
Choosing substances for field and laboratory analyses	Advice concerning which substances should be selected for testing at a specific type of site	4	Not started.	Testing of every substance listed in a schedule need not occur at every site. This selection has been done to date by applying professional judgment by consultants and regulators.
High risk contaminated site determination	Advice on how consultants and ministry staff can determine whether or not a site is a high risk site.	4	Technical content already available and in use.	This is particularly important in accessing funds for orphan contaminated sites. The ministry will consider funding the remediation of high risk orphan sites. A national procedure already exists and is to be adopted directly by the ministry.